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STUDY OF PHYSICO-CHEMICAL PARAMETERS OF SOIL OF BILAIGARH BLOCK OF SARANGARH-BILAIGARH DISTRICT, CHHATTISHGARH, INDIA

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Abstract
This research paper deals with the study of the quality and fertility of soil. In the Bilaigarh block of the Sarangarh-Bilaigarh district, Chhattisgarh, India, eight villages provided soil samples. Samples of soil were taken at a depth of 0 to 15 cm from the Sarangarh-Bilaigarh district's Bilaigarh block. Physical and chemical characteristics of soil samples were examined, such as pH, electrical conductivity, bulk density, porosity, organic carbon percentage (OC%), soil texture, and micro- and macronutrient levels. We discovered that the pH ranged from 5.00 to 7.58, the EC ranged from 0.17 to 0.76 dS/m, and the OC% ranged from 0.24 to 0.90 % with the aid of this study. From 112.80 to 284.20, 9.31 to 28.36, and 131.26 to 449.65 kg/ha, respectively, were the ranges for the N, P, and K. The nitrogen, phosphorous, potassium values are found to be low level. Also S, Fe, Cu and Mn status found in high range but Zn and B status found to be varied from deficient to sufficient range. The result of the proposed study will help the farmers to know amount of fertilizers to be added in soil to make production.

Keywords: Soil, Fertility, Porosity, Production.

1. Introduction

Soil is the fundamental resource for agriculture, and its proper management is essential to sustain crop production and maintain soil quality and fertility. Soil is important as a medium for plant growth and for supporting much animal and human activity. The soil acts as a reservoir for nutrients and water, providing the plants' needs for these requirements throughout their growth. The soil may also provide an environment for the breakdown and immobilization of materials added to the surface (in addition to the aforementioned plant and animal remains), such as fertilizers and pesticides and waste products such as sewage sludge, animal wastes and slurries, and composted refuse materials. The soil is a complex dynamic system in which the interactions of the biological, chemical, and physical environments result in the transformation of materials, possibly rendering initially harmful materials less dangerous and immobilizing others as a result of the interactions between these added materials and the organic and inorganic soil constituents.
(Tirkey *et al.,* 2017)
In recent years, agriculture development has changed from conventional and traditional farming methods to more intensive practices using chemical fertilizers and pesticides with irrigation facilities. **(Dandwate, 2020)**

Soil fertility is **the ability of a soil to sustain plant growth by providing essential plant nutrients and favorable chemical, physical, and biological characteristics as a habitat for plant growth.** Plant nutrients include the macronutrients nitrogen, phosphorus, and potassium; sulfur; calcium; and magnesium. Soil fertility is one of the most important soil characteristics for crop growth. Crops require nitrogen, phosphorus, potassium, and other nutrients at the right levels to grow properly and yield well. Fertile soils retain moderate to high levels of the nutrients needed for plant growth and a good yield.

On September 1, 2022, district Sarangarh-Bilaigarh was formed by splitting off district Raigarh and district Balodabazar-Bhatapara. It is located in the state of Chhattisgarh's northeast region. Sarangarh serves as the district's headquarters. The districts that encircle Sarangarh-Bilaigarh district include Janjgir-Champa in the north-west, Raigarh district in the north, Mahasamund district in the south, Bargarh (Orissa) district in the east, and Balodabazar district in the west. In the Sarangarh-Bilaigarh District of Chhattisgarh, India, is the major town of Bilaigarh. The districts of Sarangarh, Baramkela, and Bilaigarh comprise a total of three blocks.

The Sarangarh-Bilaigarh District mostly has clayey (Kanhar), sandy clay, sandy loam (Matasi), and laterite (bhata) soils, according to the Central Ground Water Board. The texture of the soil ranges from fine to coarse.

The following types of soils are found in Bhilaigarh block of Sarangarh-Bilaigarh District of Chhattisgarh:

- Kanhar (clayey)
- Matasi (sandy loamy)
- Dorsa (clay loam)
- Bhata (laterite)

Kanhar (clayey): A low-lying deep bluish-black soil with high moisture retention capacity. It is well suited for rabi crops, particularly wheat.

Matasi (sandy loamy): This is a yellow sandy soil, with an admixture of clay. It has a limited moisture retention capacity. Though used for paddy, it is ideal for short-duration maize and deeprooted pulses. It is found in better-drained areas and at relatively higher altitudes.

Dorsa (clay-loam): This type of soil is intermediate in terms of soil moisture retention between kanhar and matasi. This is best described as loamy and is a color between brown and yellow. This is more or less an all-purpose soil and is suitable for paddy.

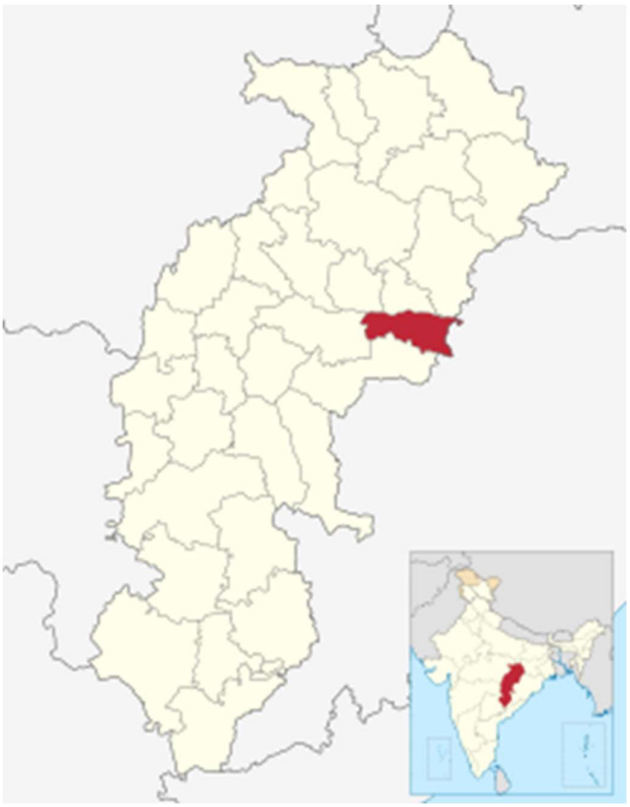
Bhata (laterite): This soil is a coarse-textured, red sandy-gravelly soil, found on upland tops. It is deficient in minerals and other productivity-enhancing nutrients and is often suitable only for coarse millets. It is low in humus content and is often wasteland.

2. MATERIALS AND METHODS

Chhattisgarh covers 1,35,194 km^2, including 1650.14 km^2 in the Sarangarh-Bilaigarh district. One block, the Bilaigarh block, in the Sarangarh-Bilaigarh district is included in this research

study. The Bilaigarh block is located in the Sarangarh-Bilaigarh district of Chhattisgarh. It is 270 meters above mean sea level and is between latitudes 21.53° N and longitude 82.16° E. At depths of 0–15 cm and 15–30 cm, soil augers, screw augers, khurpis, and farms in eight villages—Pandripani, Beltikari, Khajari, Pawni, Govindwan, Domuhani, Saliha, and Bansurkuli—were used to gather soil samples. Following collection, the samples were processed for a variety of physical and chemical testing before being allowed to air dry in the shade.

The location of study area is shown in the map of the Chhattisgarh state (Fig.1&2).



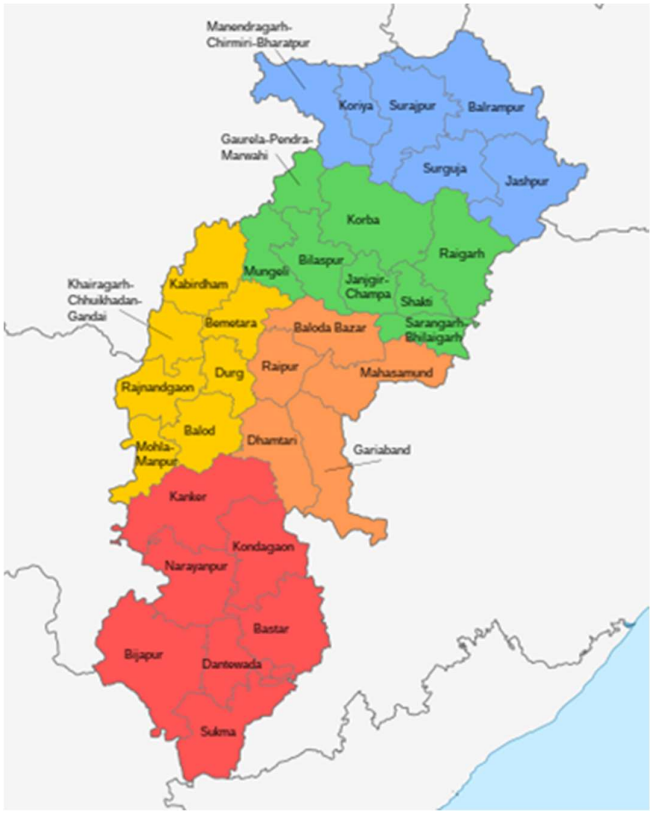


Fig.1: Map of the Chhattisgarh State

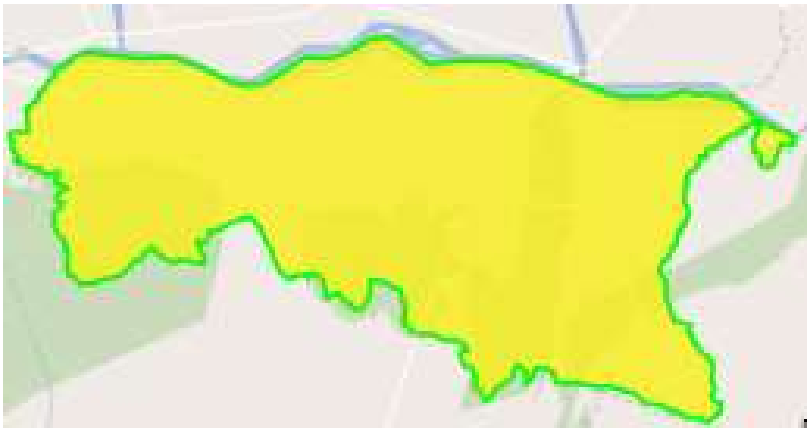


Fig. 2: Map of Sarangarh-Bilaigarh District of Chhattisgarh State

Table 1: Procedure used for Physico-Chemical Analysis of Soil

Particulars	Methods	Scientist (years)
Texture	Bouyoucos Hydrometer	Bouyoucos (1927)
Soil Colour	Munsell Colour Chart	Munsell, (1971)
Particle Density (Mg m^{-3})	Graduated measuring cylinder	Muthuaval *et al*., (1992)
Bulk Density (Mg m^{-3})	Graduated measuring cylinder	Muthuaval *et al*., (1992)
Pore Space (%)	Graduated measuring cylinder	Muthuaval *et al*., (1992)

Water retaining capacity (%)	Graduated measuring cylinder	Muthuaval *et al*., (1992)
Soil pH	Digital pH meter	Jackson, (1958)
Electrical Conductivity	Digital EC meter	Wilcox, (1950)
Organic Carbon (%)	Rapid titration method	Walkley and Black, (1947)
Available Nitrogen (kg ha^{-1})	Kjeldahl method	Subbaiah, (1956)
Available Phosphorous (kg ha^{-1})	Calorimetric method	Olsen *et al.*, (1954)
Available Potassium (kg ha^{-1})	Flame photometer method	Toth and Prince, (1949)
Calcium and Magnesium (meq/100g)	EDTA method	Tucker and Kurtz, (1961)
Zinc (meq/100g)	DTPA method	Lindsay and Norvell, (1978)

Table: 2 Physical Properties of Soil in Sarangarh-Bilaigarh District in Bilaigarh Block

Village	Sand %	Silt %	Clay%	Porosity	Bulk Density gm / cm^3
Pandripani	74.04	2.00	21.02	-0.1801	1.82
Beltikari	74.04	2.03	21.03	-0.1880	1.80
Khajari	74.90	2.05	21.01	-0.1802	1.81
Pawni	74.90	2.06	21.06	-0.1880	1.83
Govindwan	75.30	2.00	21.04	-0.1800	1.85
Domuhani	75.08	2.02	21.00	-0.1895	1.89
Salihaand	76.50	2.08	21.02	-0.1570	1.89
Bansurkuli	76.80	2.06	21.03	-0.1581	1.80

Table: 3 Chemical Properties of Soil in Sarangarh-Bilaigarh District in Bilaigarh Block

	Name of Village							
Sample Element	**Pandripani**	**Beltikari**	**Khajari**	**Pawni**	**Govindwan**	**Domuhani**	**Salihaand**	**Bansurkuli**

pH (1:2.5)	6.30	6.10	7.58	5.00	6.31	6.59	7.30	6.90
EC (dS/m)	0.27	0.25	0.19	0.09	0.17	0.36	0.49	0.76
OC (%)	0.24	0.54	0.89	0.90	0.56	0.36	0.51	0.90
N (Kg/Ha)	120.20	176.20	200.70	200.60	246.23	238.89	284.20	112.80
P (Kg/Ha)	24.04	13.44	9.31	13.35	28.36	9.86	17.30	15.16
K (Kg/Ha)	188.20	241.08	286.60	134.17	131.26	210.78	174.20	449.65
S (ppm)	18.50	18.70	51.25	17.50	36.25	39.41	20.40	7.50
Zn (ppm)	0.40	0.14	0.22	0.30	0.81	0.47	0.67	0.51
B (ppm)	0.27	1.00	0.76	0.02	0.00	0.00	0.44	0.50
Fe (ppm)	31.40	9.56	1.93	21.50	20.14	19.23	17.01	6.19
Mn (ppm)	36.50	46.61	20.10	22.60	8.56	18.23	17.01	22.69
Cu (ppm)	1.71	1.16	2.15	1.26	0.95	0.63	1.87	3.49

3. RESULT AND DISCUSSION

- **Physical Properties**

Soil texture is a physical attribute. Because it controls infiltration rates, aeration levels, tiltability, water retention in the soil, and soil fertility, soil texture is a crucial aspect of soil science. The electrical characteristics of soil are significantly influenced by the texture of the

soil. It is demonstrated that when the percentage of sand increases, the dielectric constant value drops. Additionally, as the percentage of silt increases, the dielectric constant value drops (Calla *et al.,* 2004).

The sand, silt and clay percentage ranges from 74.04-76.80%, 2.0-2.08% and 21.0-21.6% respectively. The high content of clay in most of the soil sample shows that the soil is suitable for cultivation of paddy. The same research was done by Thakre, (2012).

The porosity ranged from 0.1581% to 0.1895%, in line with findings published by Ahmadi and David (2016).The settlement of Bansurkuli had the lowest porosity (0.15811%). The settlement of Domuhani had the maximum porosity (0.1895%).

The bulk density ranged from 1.80 to 1.89 mg m^{-3}, with Bansurkuli and Domuhani & Salihaand having the lowest and greatest bulk densities, respectively. As soil depth increases, the bulk density falls. Chaudhari et al. (2013) reported similar outcomes.

- **Chemical Properties**

The pH value ranges from 5.00 to 7.58 and the highest value was recorded in Khajari. The low pH values could be due to low level of organic matter and leaching of some of nutrient elements. Similar results were reported by Upadhyay and Chawla (2014).

The electrical conductivity varied from 0.17 dS m-1 to 0.76 dS m^{-1}, with Bansurkuli having the greatest EC. For soil, an EC value of 0.5 dS m-1 is ideal. Belwal and Mehta (2014) reported similar outcomes.

The soil organic carbon percentage varied from 0.24 % to 0.90 % and the highest soil organic carbon % was found in Pawni and Bansurkuli. The organic carbon content decreased with depth. Similar results were reported by Upreti *et al.,* (2016).

The Available Nitrogen ranges from 112.80 kg ha^{-1} to 284.20 kg ha^{-1} and the highest available nitrogen was found in Saliha. The available nitrogen content found to be maximum in surface layer. Similar results were reported by Upadhyay *et al.,* (2014).

Saliha has the maximum amount of accessible nitrogen, which ranges from 112.80 kg ha-1 to 284.20 kg ha-1. The surface layer was determined to have the highest accessible nitrogen content. Upadhyay et al. (2014) reported similar results.

The Available Phosphorus ranges from 9.31 kg ha^{-1} to 28.36 kg ha^{-1} and the highest available phosphorus was found in Govindwan. The available phosphorous content found to be maximum in surface layer and randomly it varies with depths. Similar results were reported by Sannappa and Manjunath (2013).

The Available Potassium ranges from 131.26 $kgha^{-1}$ to 449.65 kg ha^{-1} and the highest available potassium was found in Bansurkuli. Similar results were reported by Patel, (2015).

The range of accessible potassium is 131.26 kgha-1 to 449.65 kgha-1, with Bansurkuli having the maximum potassium available. Patel (2015) reported similar outcomes.

The Available sulpher ranges from 7.50 ppm to 51.25 ppm and the highest available sulpher was found in Khajari.

The range of accessible sulfur is 7.50 ppm to 51.25 ppm, with Khajari having the largest amount.

The Available zinc ranges from 0.14 ppm to 0.81 ppm and the highest available zinc was found in Govindwan. Availability of zinc decreases with increase in soil pH. Similar results were reported by Shukla, (2015).

The Available boron ranges from 0.00 ppm to 1.00 ppm and the highest available boron was found in Beltikari.

The Available iron ranges from 1.93 ppm to 31.40 ppm and the highest available iron was found in Pandripani.

The Available manganese ranges from 8.56 ppm to 46.61 ppm and the highest available manganese was found in Beltikari.

The Available copper ranges from 0.63 ppm to 3.49 ppm and the highest available copper was found in Bansurkuli.

4. CONCLUSION

It is crucial to analyze the physico-chemical characteristics of soil, such as pH, bulk density, texture, porosity, electrical conductivity, organic carbon, and macro and micronutrients. Due to plant absorption and leaching, soil nutrients decrease as depth increases. The soil's organic matter content was moderate. The pH of the soil is crucial because different pH ranges affect the amount of macro and micronutrients in the soil. This investigation showed that the soil in the Sarangarh-Bilaigarh district of Bilaigarh was productive and fertile, making it suitable for cultivation. It is possible to cultivate broad beans, cabbage, cauliflower, tomato, brinjal, chilli,

rice, arhar, gram, lentil, lineseed, and mustard. In order to enhance soil health and save cultivation costs, appropriate integrated soil.

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